

Office of Technical Assistance Research Proposal
Low VOC Alternatives to Solvent-based Wood Adhesives

BACKGROUND

Wood adhesives make an appearance in Massachusetts both in their manufacture and in their widespread use within the furniture, fixtures, and cabinet-making industries. Many wood adhesives are currently solvent-based, presenting health and regulatory issues for their users. Therefore, the development of TUR techniques, either in development of new water-borne or low-VOC solvent-based adhesives or in modification of the adhesives application process, would be extremely beneficial to industry and the public in the Commonwealth. This proposal deals primarily with adhesives used for plastic/Formica laminates and wood veneers.

Solvents act primarily as carriers within the adhesive. Once applied, these solvents evaporate from the adhesive, leaving a high-viscosity tack which can then be bonded to a wood substrate. This evaporation time is known as the “open time”. One of the significant advantages of solvent-based products is their relatively short open time, allowing for decreased production times. Solvents are also used to control the pre-application viscosity of the adhesive. However, many of the solvents in use are characterized as VOCs and/or hazardous air pollutants (HAPs) and are harmful both to the environment and to human health. Toluene, for example, a solvent commonly found in adhesives, is known to adversely affect both the nervous system and the kidneys. Long-term effects include confusion, weakness, memory and hearing loss, and nausea among other symptoms. Short-term high-level exposure can result in dizziness, loss of consciousness, and even death.

Awareness of these dangers and increased regulatory measures have led to the development and industry use of high-performance water-borne adhesives, as well as solvent-based adhesives that contain a comparatively small amount of VOCs. However, there remain a number of obstacles to their widespread dissemination:

- Low elasticity and bond strength. Delaminating has occurred after the application of water-borne adhesives in long-term testing. It was found that this is due in part to the brittle nature of the adhesives. This is an issue especially with pieces exposed to periodically varying temperatures (e.g. from daily light exposure), as the bond must be flexible enough to shift with the expansion and contraction of the wood.
- Long open times, varying wildly with humidity. Also, unless the adhesive is completely dry at the time of bonding, bubbling may occur.
- Grain raising and wood swelling in veneer applications. Due to the porosity of wood veneers, movement of water through the body of the wood causes serious surface deformity. This issue has been addressed somewhat with the use of phenol resin backings.

SCOPE OF PROBLEM

The use of wood adhesives is covered under several SIC codes. Below is a table of possibly affected Massachusetts industries, along with the number of facilities falling under each SIC code:

<u>SIC code</u>	<u>Description</u>	<u>No. of facilities in MA</u>	<u>No. of employees in MA</u>
2434	Wood kitchen cabinets	87	617
2452	Wood prefabricated components	3	34
2511	Wood household furniture	65	1,493
2521	Wood office furniture	9	159
2541	Wood, office and store fixtures	14	307
2599	Furniture and fixtures, NEC	21	933
TOTALS		191	3,543

From the manufacturing perspective, 42 companies in Massachusetts make adhesives and sealants (SIC 2891), with a total of 1,979 employees. A rough estimate based on the 1999 TURA data suggests that the total yearly solvent use in Massachusetts in adhesives is in the area of 20 million pounds. A successful reformulation of water-borne adhesives could therefore have a tremendous impact on toxics use in the state.

OBJECTIVE

There are several potential areas of research related to this issue. The first and perhaps the most promising is the development of a water-borne or low-VOC adhesive that performs up to industry standards for use in laminating processes. This research should examine the previous test results for existing products, and should look to address the issues described above, namely long open times, low bond strength, and performance variation with humidity. An improvement in any one of these areas would be quite beneficial. A second direction would be to explore the technical problems associated with water-borne adhesive use for veneers and work towards developing a viable substitute.

Candidates should be subjected to the standard battery of tests and specifically to cyclic fluctuations in temperature over the long term; this should also include pilot testing. EPA's MACT standard for wood furniture manufacturers is 1 kgVHAPs/kg Solids for existing sources; obviously we would want substitutes with HAP content below this threshold. As noted above, there are many adhesives manufacturers in Massachusetts that may be interested in industry partnerships. One chemical company has specifically expressed interest in such a project.